U1 HP Turbine Upgrade Acceptance Test Results Summary

	Acceptance Tests		Confirmation Tests				Pre-
	Test 8	Test 9	Test 10	Test 11	Average	Guarantee	Upgrade
HP Turbine Efficiency (%)	92.7	92.6	92.2	92.1	92.40	92.20	83.48
HP TurbineWheel Power (Mw)	301.3	301.7	295.5	296.7	298.78	299.0	
Throttle Flow (kpph)	7,004	7,007	6,810	6,849	6,918	6,900	6,541
IP Turbine Efficiency (%)	92.22	92.29	91.39	91.19	91.77		91.23
Net Turbine Cycle Heat Rate (Btu/kwh)		7,723	7,721	7,669	7,704	7,683	7,963
Gross Power (Mw)		985.6	979.0	979.6	981.4	973.2	888.0

Notes:
All tests conducted at turbine throttle valves wide-open.
Tests 8 & 9 conducted by PGT with test instrumentation. Refer to the Thermal Peerformance Test Results on Intermountain Power Project (IPP) Unit #1 Turbine Cycle test report (April 2003) for additional information.
Problems with feedwater heater 6 alternate drains during test 8 invalidated the heat rate and gross power evaluation for this test.
Tests 10, 11 & pre-upgrade tests used station instrumentation corrected to test instruments readings.
HP turbine efficiency - PGT test uncertainty ±0.292%, enthalpy drop efficiency calculated with inlet conditions measured before stop valves, exhaust measured after balance gland leakage flow mix.
HP turbine wheel power - PGT test uncertainty ±2.497%, throttle flow corrected to design conditions (2412.2 psia, 1000°).
Throttle flow - PGT test uncertainty ±2.527%, corrected to design throttle conditions (2412.2 psia, 1000°).
IP turbine efficiency - Enthalpy drop efficiency calculated with inlet conditions measured before combined reheat valves and exhaust measured at LP-A turbine inlet (PGT), 14th stage extraction (Station).
Net turbine cycle heat rate - PGT test uncertainty ±2.556%, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.
Gross power - PGT test uncertainty ±0.458%, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IPSC

INTERMOUNTAIN POWER SERVICE CORPORATION

UNIT 1 HP TURBINE FACTORY INSPECTION REPORT

Dated 12/10/02

Summary & Recommendation

The on-site quality assurance and inspection of the Unit 1 (U1) HP turbine rotor, diaphragms, buckets, and high speed balance witnessing was done at Alstom, Rugby, United Kingdom between December 1 and 7, 2002.

The primary work scope consisted of a spot check and visual inspection of the fit, clearances, coupling, bearing journal, rotor run out, control rotor machining, and dynamic over speed balancing. The overall HP rotor high speed's peak-to-peak vibration was extremely good with the maximum displacement at the 2^{nd} critical speed (4170 rpm) of 0.0002". (Refer to Appendix B.)

In addition, the last Unit 2 (U2) turbine outage check list, and the upcoming U1 turbine outage work scope, including the possible U1 IP Faro Arm measuring were discussed. The March 2002 U2 outage report indicated severe damage on the IP 8^{th} stage double flow diaphragms, the 8^{th} stage bucket, and excessive run out (7 mils TIR) on the IP rotor. The 9^{th}, 10^{th}, 11^{th}, and 14^{th} stage diaphragms also subjected to FOD damages. The reports recommend to (a) replace, on the next HP/IP outage window, the 8^{th} stage buckets, (b) repair/replace the 8^{th}, 9^{th}, 10^{th}, 11^{th}, and 14^{th} stage diaphragms, and (c) re-machine the IP rotor if run out is progressing to the maximum allowable limit of 10 mils. However, replacing the existing IP rotor and diaphragms with a more efficient dense pack is surely an alternative to maximize the turbine reliability and efficiency. Economic, safety, and operational reliability analysis would identify the best resolution.

The March 2003 U1 HP/IP turbine overhaul provides a unique opportunity for measuring the IP. Alstom's Faro Arm measuring devices and technicians are already scheduled to be onsite during this outage for the U1 HP retrofit. Alstom would provide this service at no cost, without any interference with the outage. Therefore, it is recommended allowing Alstom to measure the U1 IP during the upcoming March 2003 outage.

Concerns of the HP end balance hole line up, low speed balance, startup and performance testing were also resolved.

Alstom strongly recommends keeping the high speed (factory) balanced weights on turbine rotors during low speed balancing. Throughout their retrofit experiences, removal of all high speed factory weights proved to cause a significant vibration and troublesome startup. The issue has been discussed with IPSC's Performance Group. Alstom formal letters of recommendation (LOR)

New technology of the shell horizontal hydraulic bolts was presented by Hydratight Sweeney Comp. of England and Technofast Comp. of Australia. The hydraulic bolting system has been used widely with good success over the past 14 years within power generation, mining, steel, petroleum, and civil industries. The new hydraulic bolting technology would reduce our turbine shell bolting/unbolting time, a critical path of the turbine overhaul, from 20 hours to four hours, average. Additional studying/cross check of this technology will be conducted by IPSC Engineering.

The factory-built final report and associated drawings will be supplied by Alstom by the 2nd week of February 2003.

The U1 HP rotor and cylinder will be shipped by the 1st week of January and will be on the site by the 2nd week of February 2003.

Process Control Guides

Activity Description	QA Instructions References	Comments	Verified Date
A coupling, HP half	Alstom/GE	Completed	12/02
Inner shell feeler check	Alstom/GE	Carried Out	12/02
Rotor run out	Alstom/GE	Completed	12/02
Packing and wheel clearances	Alstom/GE	Carried Out	12/02
NDE reports on rotor, shell, diaphragms, bolts, casing	Alstom/GE	Carried Out	12/02
T1 & T2 journal areas	Alstom/GE	Completed	12/02
Diaphragm sideslips	Alstom/GE	Carried Out	12/02
Control coupling, HP half	On the U2 Alstom HP control rotor, there were only eight tapped holes whereas the control rotor had twelve bolt holes and four jacking holes.	Completed	12/02
HP rotor machining drawing Alstom R201/A0/3249 update	Update the drawings to the new hole numbers and dimensions	Completed	12/02
HP U1 1% flow reduction (6,915,600 lb.hr) by changes made to stage 1 and 6 diaphragms (fixed blades)	Check the drawing, part identification.	Completed	12/02
HP End Balance Holes Line Up	Obtain drawings & details of drill & tap Obtain details for new plugs Measurements Incorporate these steps into Alstom installation time line/program	Completed	12/02
Review Alstom Work Built Report	Check clearances, run out...	Carried Out	12/02
Retractable	Alstom/GE	Carried Out	12/02

IP7007249

FOR UNIT 1 HIGH PRESSURE TURBINE

Activity Description	QA Instructions References	Comments	Verified Date
Onsite radial and axial clearances	Alstom/GE	Carried Out	12/02
A coupling honing and machining	Alstom/GE	Carried Out	12/02
Control coupling honing and machining	Alstom	Completed	12/02
High Speed Balance	Alstom/GE	Completed	12/02
Balancing Weight	Alstom/GE	Completed	12/02
Thread chaser and other tools	Alstom/GE	Completed	12/02
U2/U1 performance	Go over the test tolerances	Completed	12/02
Low Speed Balance	Low speed balance procedure	Completed	12/02
Outage planning, startup	As required	Completed	12/02

High Speed Dynamic Balancing

The high speed dynamic balancing was completed twice, with five minutes over-speed intervals, on the Unit 1 HP completed bladed rotor. The rotor went through the 1st critical (1930 rpm) and 2nd critical (4170 rpm) speeds with exceptionally low vibration. The maximum peak-to-peak displacement vibration is 3.6 micro inches (0.0002"), better than that of the U2's HP (13.6 micro inches.) The Alstom maximum acceptable is 16.0 micro inches and GE maximum acceptable is 25.0 micro inches. Refer to the Table 1 and attached graphs.

	Vibration, Displacement, Peak-to-Peak		
Speed, rpm	HP Rear, in	HP Front, in	Comment
1850	0.00002	0.00002	
3600	0.00001	0.00004	
3960	0.00010	0.00008	
4170	0.00020	0.00005	
4320	0.00007	0.00015	

Rotor Run Out

All rotor's run out dimensions are found to be better than the limits. Refer to the attached drawing.

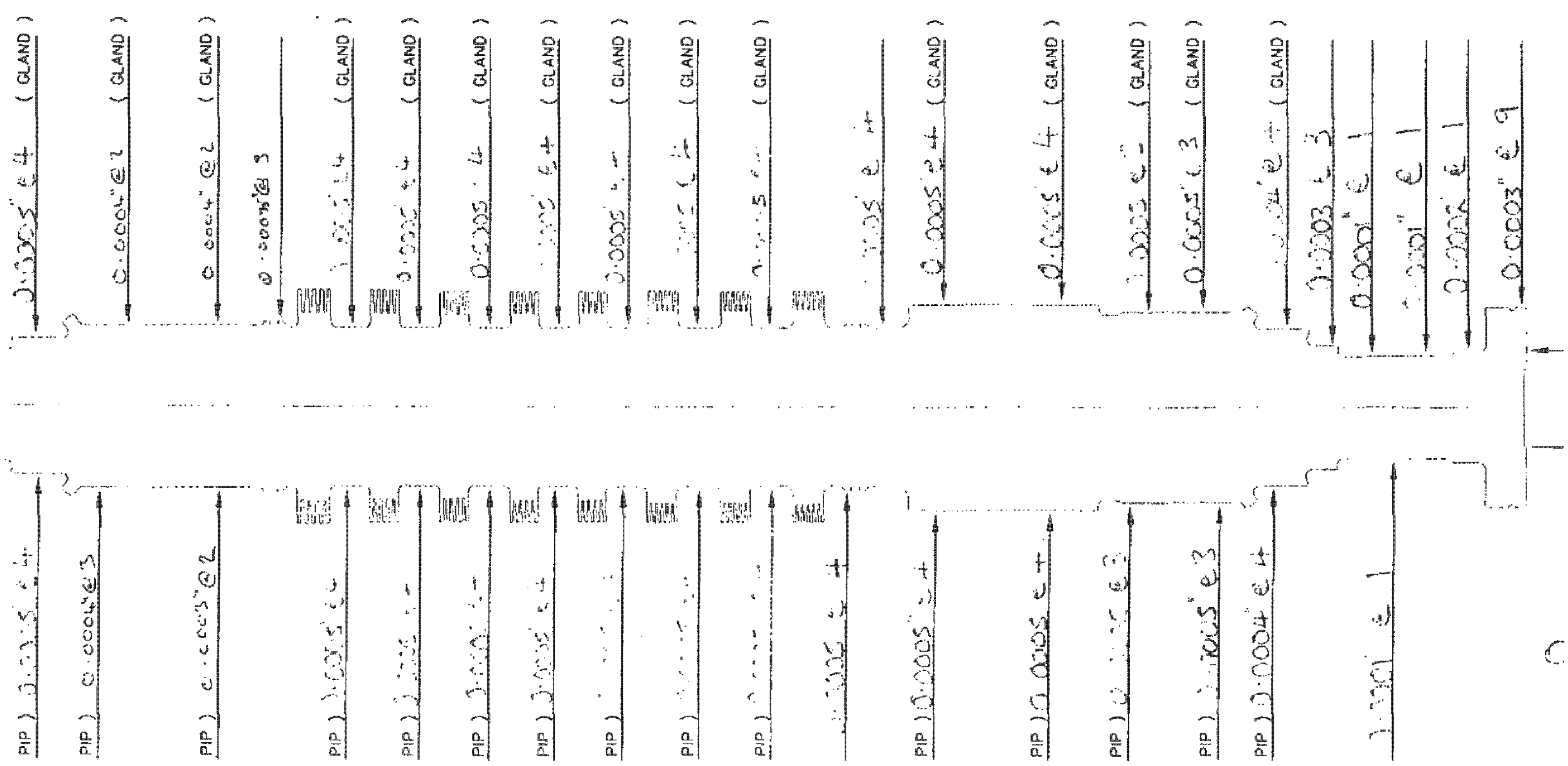
APPENDIX A - ROTOR RUN OUT

tors Limited

CLOCK READINGS FOR ROTOR TRUTH CHECK

READINGS TAKEN LOOKING FROM FRONT TO REAR,
USING ROTOR DATUM "0" AS 12 O'CLOCK.

MACHINED ROTOR WEIGHT: –



RMOUNTAIN HP ROTOR

/3249

TEST No. : –

INSPECTOR : –

DATE : –

APPENDIX B - HIGH SPEED BALANCE

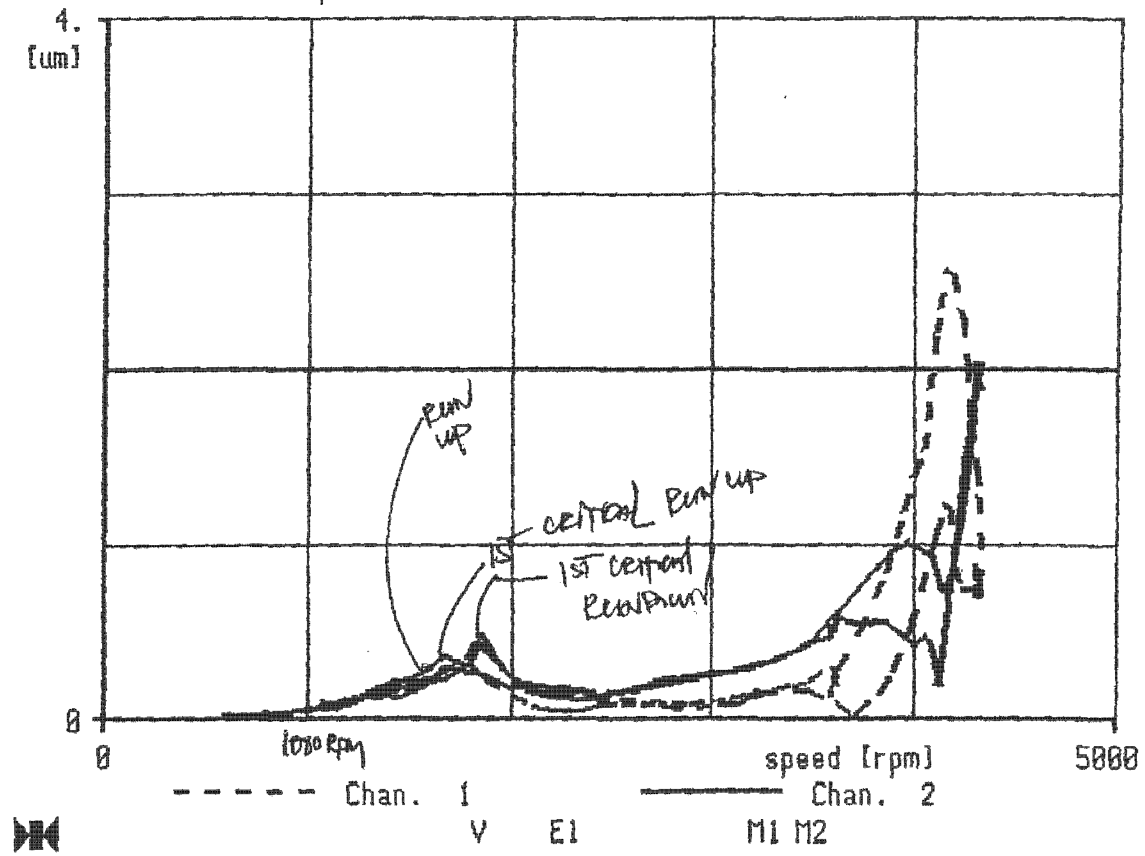
Rugby G.B.

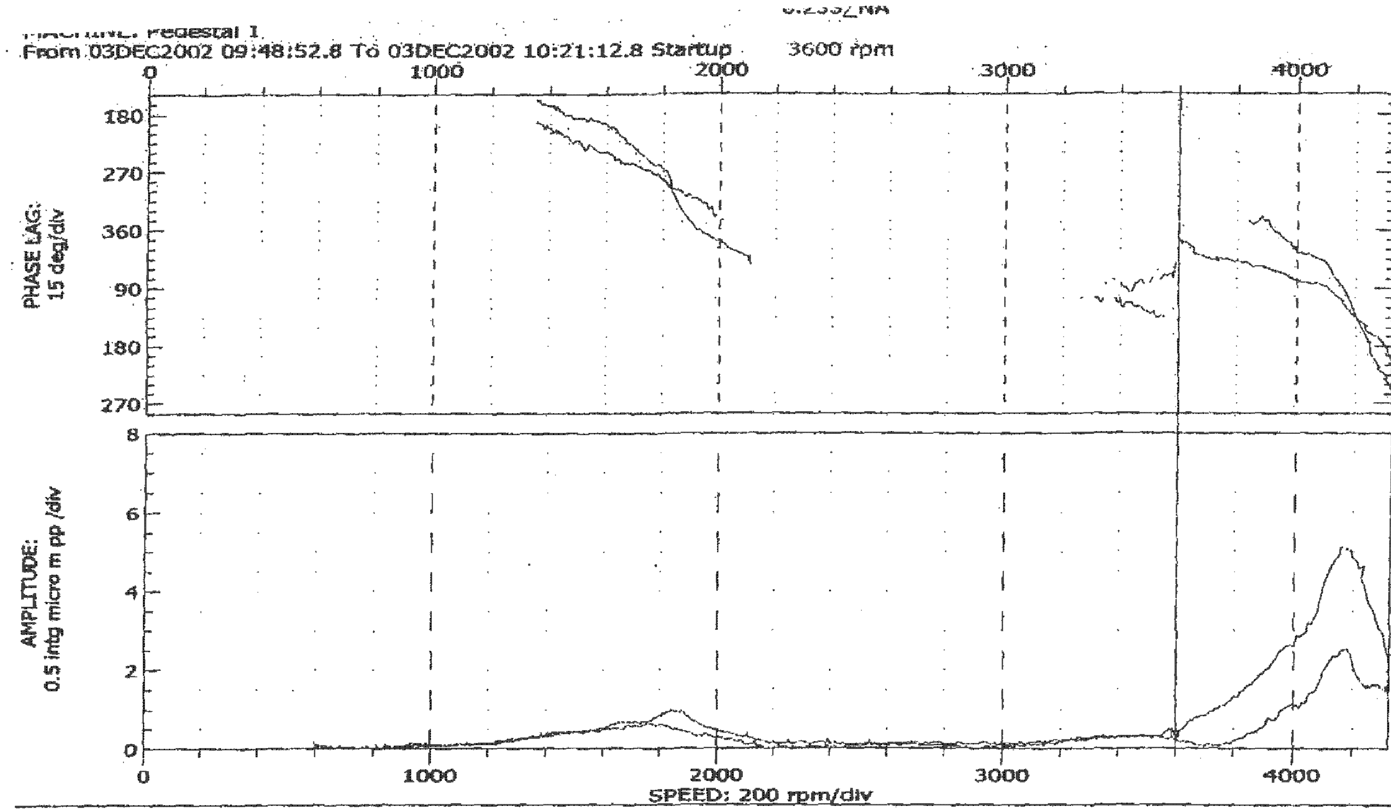
****

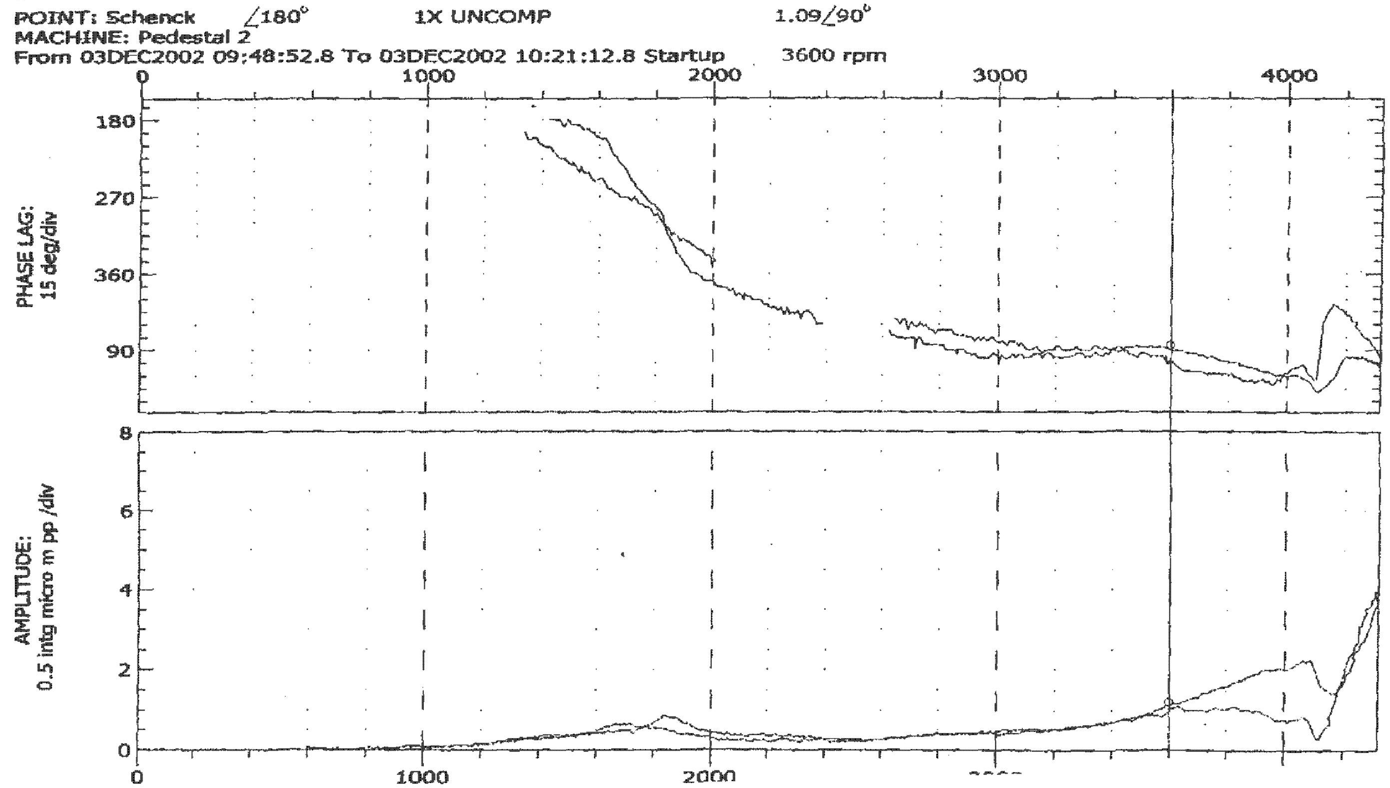
operator : N.ARMSTRONG 03.12.02 10:18

file name : INTERMOUNTAIN 1HP HS

vibration displacement rotor : RF113218.




MACHINE: Pedestal 1
0.233∠NA
From 03DEC2002 09:48:52.8 To 03DEC2002 10:21:12.8 Startup
3600 rpm
PHASE LAG:
15 deg/div
AMPLITUDE:
0.5 intg micro m pp /div
SPEED: 200 rpm/div


POINT: Schenck ∠180°
1X UNCOMP
1.09∠90°
MACHINE: Pedestal 2
From 03DEC2002 09:48:52.8 To 03DEC2002 10:21:12.8 Startup
3600 rpm
PHASE LAG:
15 deg/div
AMPLITUDE:
0.5 intg micro m pp /div

IP7007256

Rugby G.B.

****

operator : N.ARMSTRONG   03.12.02 10:23

rotor data   setup 1   INTERMOUNTAIN 1 HP

a: 1950. mm   b: 2129. mm   c: 1204. mm

r1: 309.0 mm   2-plane   r2: 313.0 mm

m1: +polar   m2: +polar

tol1: 24.00 kgmm   tol2: 24.00 kgmm

set speed : 600. rpm

readout   rotor: RF113213   03.12.02 10:23

run 1   act speed : 600. rpm

pl 1: 23.0 g   pl 2: 9.67 g

168. deg   142. deg

in tol   in tol

correction in tol. units :
7.097 kgmm   3.025 kgmm

IP7007257

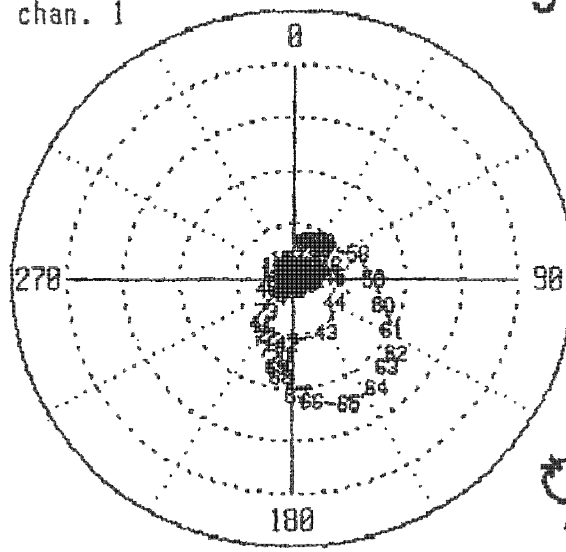
Rugby G.B.

****

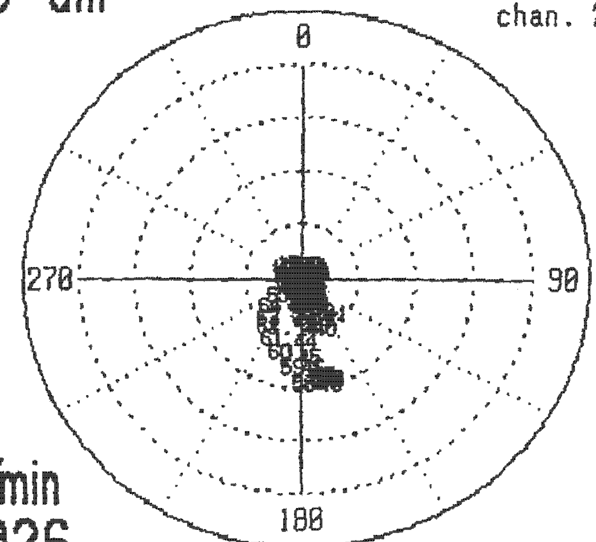
operator : N.ARMSTRONG 03.12.02 10:17

5.0 um

chan. 1



chan. 2



⟳/min
1026.

chan. 1		chan. 2
0.05 um at 123 deg	runs : 1 values : 123	0.08 um at 218 deg

V E1 M1 M2

IP7007258

Subject: Re: Intermountain U1 Over Speed Result

Hi Phong

Thanks for your email.

Here is Nigel's reply which confirms we are right.

Hope this answers your query.

Regards

Kevin
---------------------- Forwarded by Kevin SPIRES/GBRUG01/Power/ALSTOM on 11/12/2002 11:57 ---------------------------

Nigel ARMSTRONG
11/12/2002 11:51

To: Kevin SPIRES/GBRUG01/Power/ALSTOM@GA
cc: Dave MURPHY/GBRUG01/Power/ALSTOM@GA, Bob MITCHELL-KING/GBRUG01/Power/ALSTOM@GA

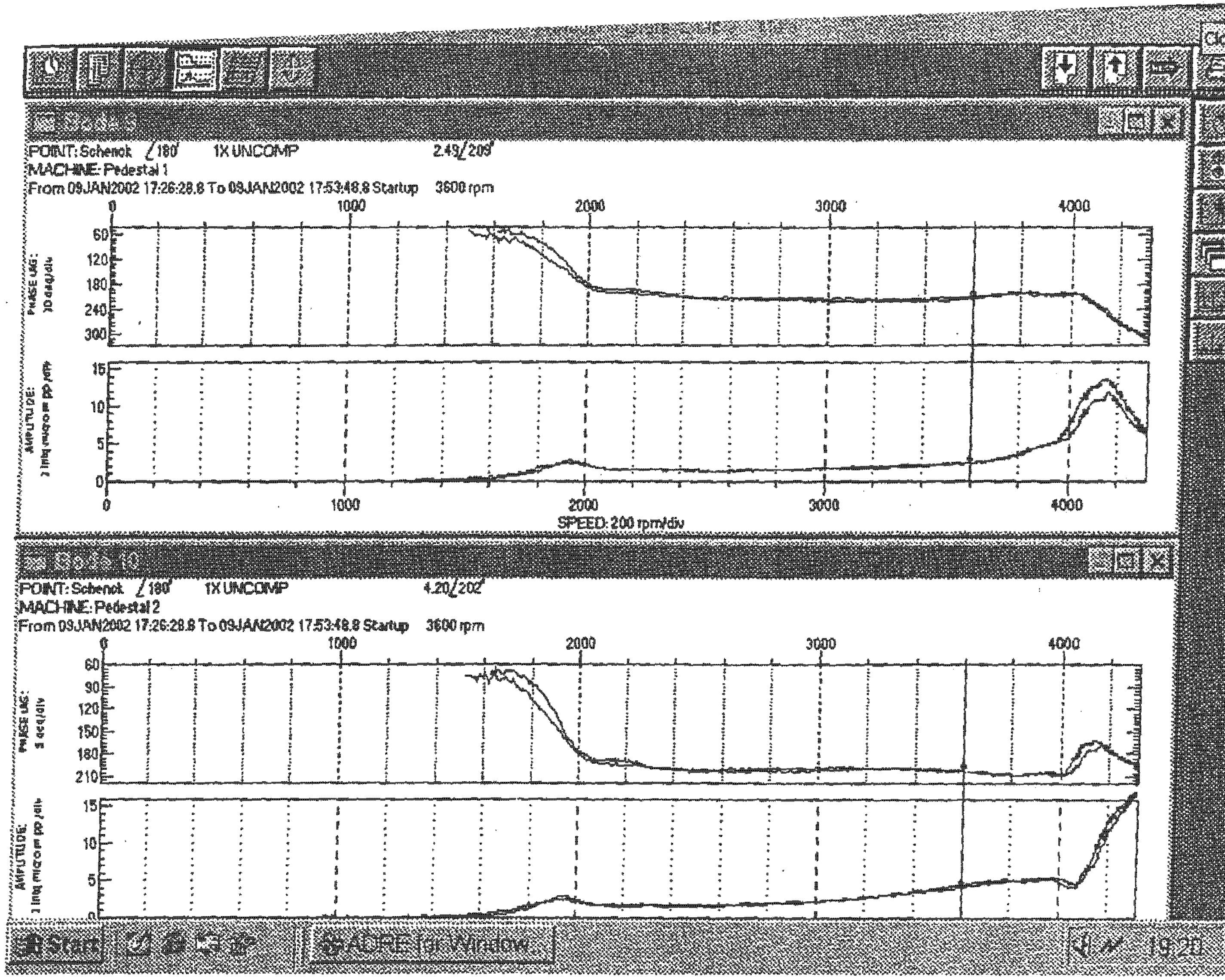
Subject: Re: Intermountain U1 Over Speed Result (Document link: Kevin SPIRES)

Kevin,
I will confirm the numbers are correct and extremely good, they are not however unusual for this type of shaft as manufactured and balanced here.
In inches we are allowed according to Rugby Specification 601/0020 at 3600 RPM 0.00032" Pk/ Pk (Vertical Pedestal movement) we are allowed double that at any other speed.
For this rotor the Pk/Pk readings are as follows.

Speed RPM	Ped 1	Ped 2
1850	0.0000208"	0.0000196"
3600	0.0000116"	0.0000412"
3960	0.0000996"	0.00008"
4170	0.0002036"	0.000048"
4320	0.0000716"	0.000148"
	HP Rear	HP Front

If any doubts remain I would suggest that station can talk to two of our previous retrofit customers:-
1) Miller because when the first unit ran station staff had to double check their instrumentation to see if it was actually working .
2)Spruce, because they would not have believed the overspeed vibration numbers if they had not witnessed the whole process themselves and had it reconfirmed when the machine was installed and first run at site.

IP7007259


POINT: Schenck ∠180° 1X UNCOMP 2.49∠209°
MACHINE: Pedestal 1
From 09JAN2002 17:26:28.8 To 09JAN2002 17:53:48.8 Startup 3600 rpm
PHASE LAG: 30 deg/div
AMPLITUDE: 3 mil microm pp /div
SPEED: 200 rpm/div
POINT: Schenck ∠180° 1X UNCOMP 4.20∠202°
MACHINE: Pedestal 2
From 09JAN2002 17:26:28.8 To 09JAN2002 17:53:48.8 Startup 3600 rpm
PHASE LAG: 5 deg/div
AMPLITUDE:
Start
ADRE for Window...
19:20

IP7007260

	A deg		B deg	weights
Front Coupling	-	-	-	-
Front Disc	55	1	-	-
Front Mid Disc	-	-	-	-
Rear Mid Disc	-	-	-	-
Rear Disc	165	1	-	-
Rear Coupling	-	-	-	-

R.P.M.	Front Ped um	Rear Ped um	um
1940	2.78	2.78	16
3600	2.49	4.2	8
3960	5.34	5.46	16
4160	13.6	9.7	16
* 4320	6.78	17.1	16
	HP REAR	HP FRONT	

The attached statement gives vibration levels at other speeds.

All vibration levels peak to peak in um.

um = 0.001 inches.

1 gram metre (g.m.) = 1.4 oz.in.

LOW SPEED BALANCE			
Balancing Speed R.P.M	Residual O.O.B		
	Front Ped. 1 g.m.	Rear Ped. 2 g.m.	Max Specified g.m.
600	10.94	11.04	24

The test was witnessed by :-

....

....

COMMENTS.

ROTOR OVERSPEED TO 4320 RPM (20% OVERSPEED) FOR 5 MINUTES.
* PERFORMANCE ACCEPTED BY DESIGN DEPARTMENT.

APPENDIX C - HORIZONTAL JOINT HYDRAULIC BOLTING

Email: sales@technofast.com
Web: www.technofast.com

REFERENCE LIST – OEM & POWER GENERATION

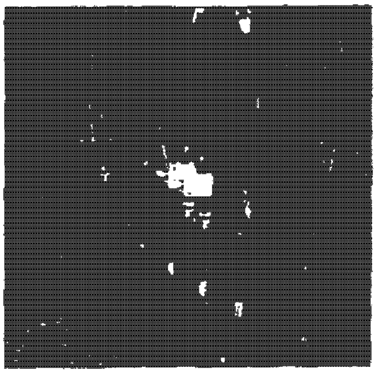
OEM's

Mitsubishi Electric	Generator Core Bolting
Toshiba	Reactor Feed Pump Turbine
Kawasaki	Vibration Units and Presses
Hyundai	Dock Crane Cablewinders
Samsung	Dock Crane Cablewinders
Hitachi	Injection Clamping Equipment
Bellelli	Heat Exchangers
Alfa Laval	Heat Exchangers
Kelly and Lewis	Pumps
Fiat	Presses
Favelle Favco	Cranes
Danieli	Presses
ANI	Crushers / Mills
Svedala	Mills / Screens
Sulzer	Boiler Feed Pumps

POWER GENERATION

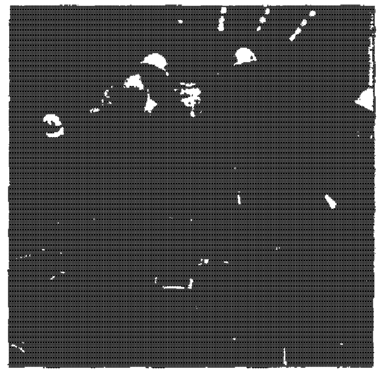
Tarong Energy	Generator Winding Jacks
Mitsubishi Electric	Generator Rotor Core Bolting
AES	Boiler Feed Pumps
Toshiba	Reactor Feed Pump Turbines
Pacific Power	Boiler Feed Pump Suction
Delta Energy	HP Heater Manway Doors
Virginia Power	Westinghouse Steam Valves
Maquarie Generation	Shaft Raising Gear
Alstom	Coupling Hole Boring
Stanwell Corporation	Boiler Sling Rod Analysis
CS Energy	Turbine Casings
Iberdrola	GE Turbine Casings
Westinghouse Electric	Reactor Pressure Vessel Covers
Dominion Power	Reactor Coolant Pumps
KOSPO	Gas Turbine Casings

Successes



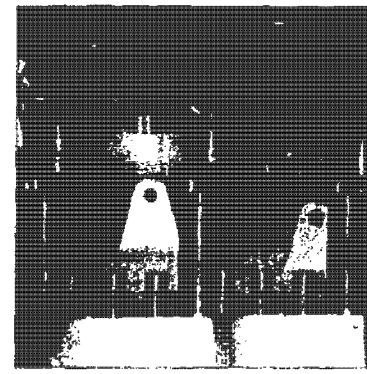
High Temp Nuts - Shimane

- 15 day reduction
- $8 million saved



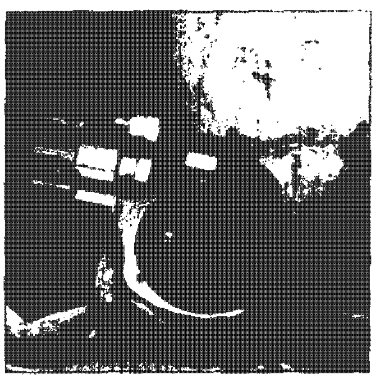
Induction Heating - Hendrina

- 4 day reduction
- $400,000 saved



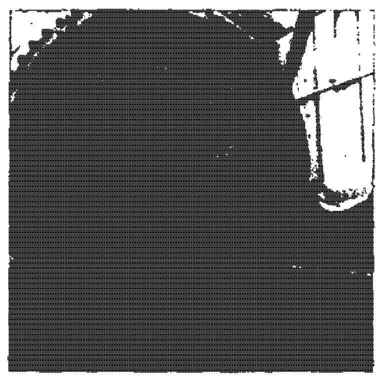
Steam Turbine - Genessee

- 19 hour reduction
- $300,000 saved



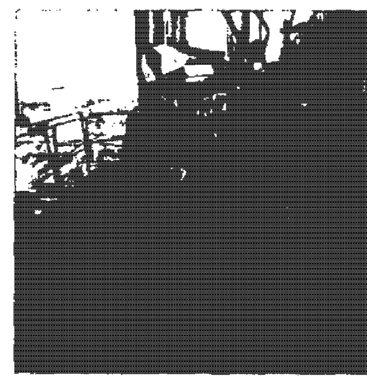
Torque Wrench

- USA Limerick job
- Made possible due to compact size



Services - Drax

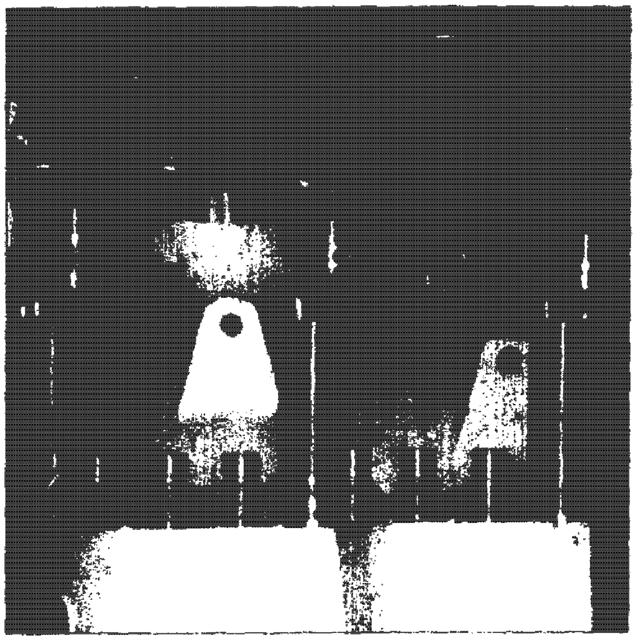
- Successful packaged services
- Wide capability range



Standard Tensioners - Florida Power & Light

- Repair & replacement halted
- $30,000 saved

Custom Designed Bolt Tensioners



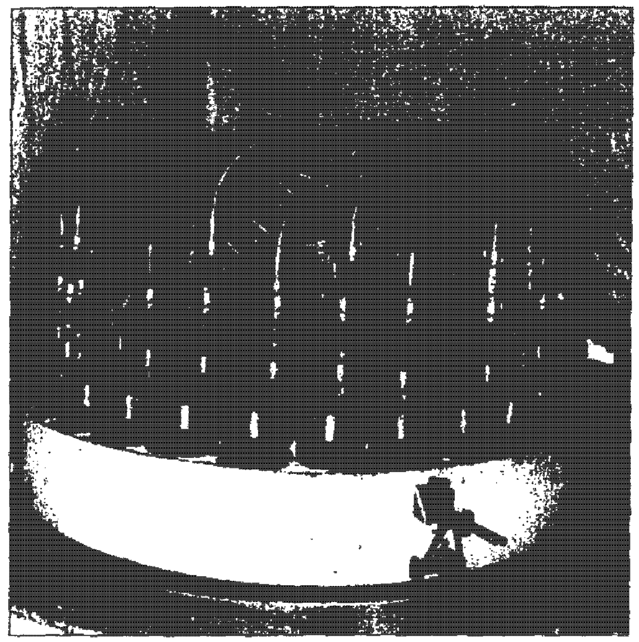
ALSTOM STEAM TURBINE CLOSURE
- GENESSEE, CANADA

GAS COMPRESSOR CASING - ITALY

- USED FOR CRITICAL JOINTING APPLICATIONS TO REDUCE OUTAGE TIME
- SUPPLIED AS A STANDARD FOR MANY GAS AND STEAM TURBINES
- SUPPLIED AS A RETROFIT FOR TURBINE AND VALVE APPLICATIONS
- DESIGNED TO FIT IN A RESTRICTED SPACE
- EXTENDED BOLT THREAD REQUIRED (0.8 x DIAMETER)
- CAN BE MANIFOLDED TOGETHER TO GIVE FAST, EVEN CLOSURE

High Temperature Hydraulic Nut

LP CASING - SHIMANE NUCLEAR JAPAN



MSV COVER - KASHIWAZAKI NUCLEAR JAPAN

- THE ULTIMATE TIME REDUCTION IN BOLTED JOINTS
- ADDRESSES CRITICAL PATH APPLICATIONS - TURBINES VALVES, PUMPS ETC
- SUPPLIED FOR NUCLEAR CV. MSV. TBV. LP AND RFP-TB APPLICATIONS
- SUPPLIED FOR GAS TURBINE HALF JOINT APPLICATIONS
- CONNECTED TO ONE PUMP FOR INSTANTANEOUS, EVEN CLOSURE OF CRITICAL JOINT

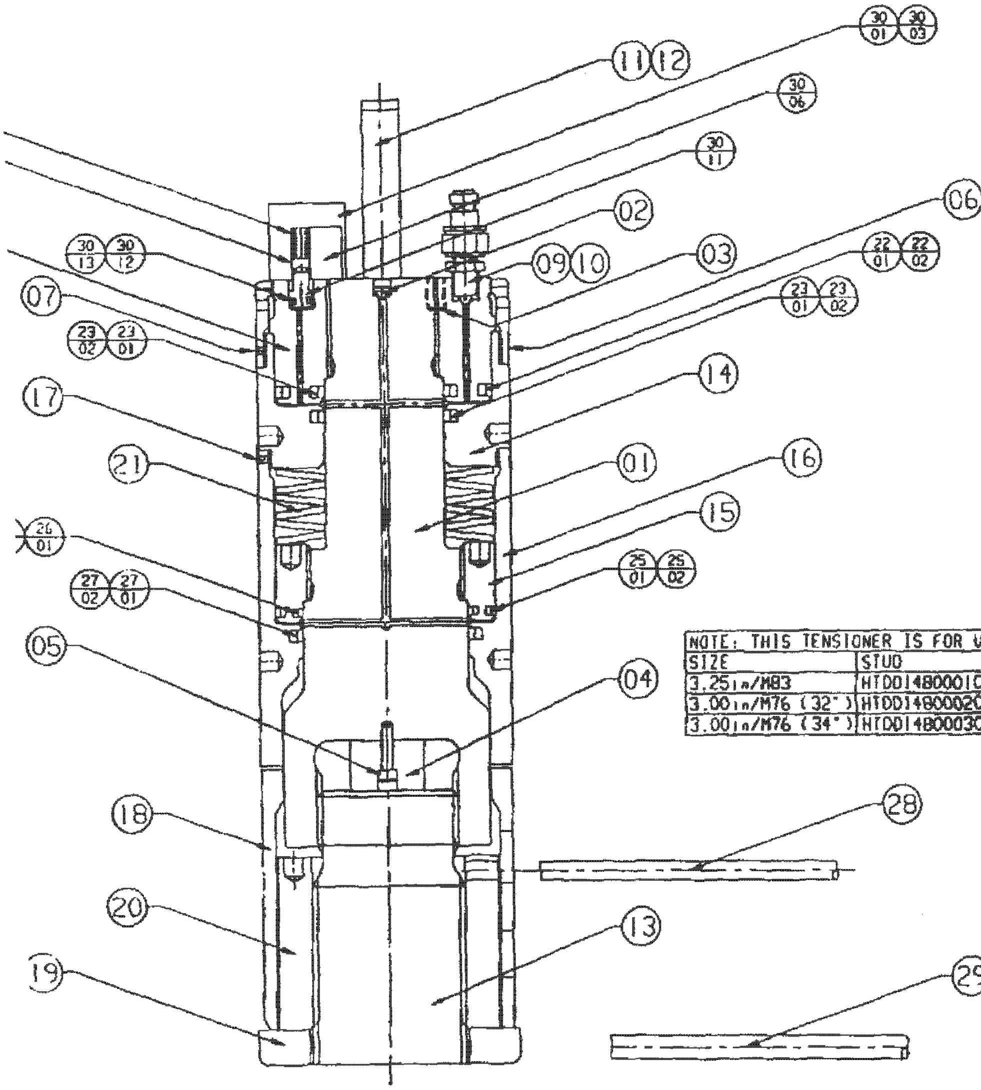
IP7007266

B C D E F G

ALL DIMENSIONS IN
MILLIMETERS UNLESS STATED

IF IN DOUBT
ASK

THIRD ANGLE
PROJECTION



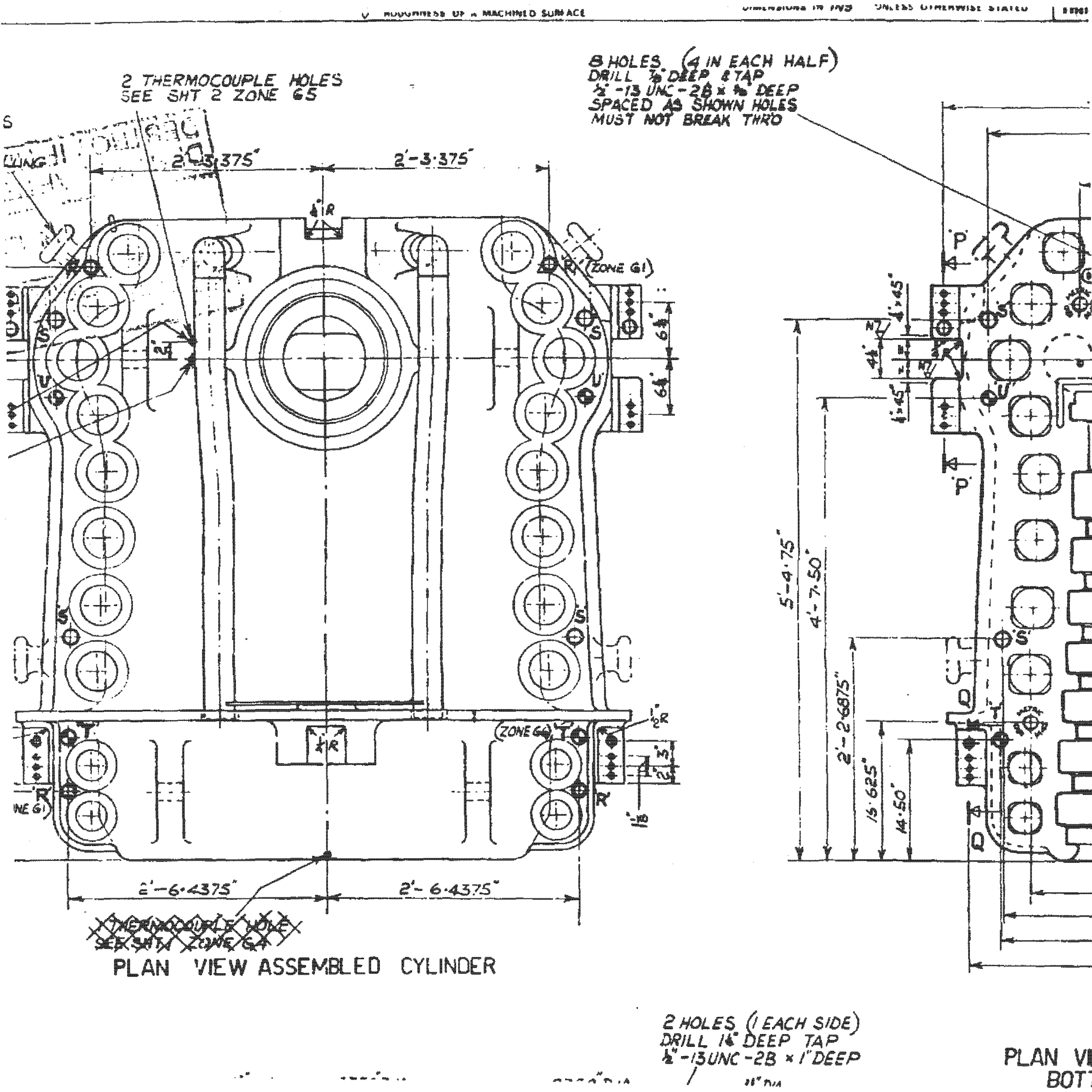
NOTE: THIS TENSIONER IS FOR USE ON 3 DIFFERENT SIZE STUDS:			
SIZE	STUD	RING NUT	WASHER(/WITH FLAT)
3.25in/M83	HTDD1480001C	HTDD1480004D	HTDD1480008D/11D
3.00in/M76 (32")	HTDD1480002C	HTDD1480005D	HTDD1480009D/12D
3.00in/M76 (34")	HTDD1480003C	HTDD1480005D	HTDD1480009D/12D

ITEM	SUB	DESCRIPTION	P
	13	O-RING	
	12	OD SEAL	
	11	COUNTER PISTON	
	10	N/A	
	09	N/A	
	08	COUNTER MAGNET	
	07	DISC SPRING	SP
	06	MECHANICAL COUNTER UNIT	
	05	N/A	
	04	N/A	
	03	CAP SCREW (GR 12.9)	
	02	N/A	
	01	COUNTER HOUSING	
30	00	CYCLE COUNTER ASSEMBLY	
29		TOMMY BAR	
28		TOMMY BAR	
	02	O-RING	
	01	ID SEAL	
27	00	LOWER ID SEAL SET (BOT)	
	02	O-RING	
	01	ID SEAL	
26	00	LOWER ID SEAL SET (TOP)	
	02	O-RING	
	01	OD SEAL	
25	00	LOWER OD SEAL SET	
	02	N/A	
	01	N/A	
24	00	N/A	
	02	O-RING	
	01	ID SEAL	
23	00	UPPER ID SEAL SET	
	02	O-RING	
	01	OD SEAL	
22	00	UPPER OD SEAL SET	
21		DISC SPRING	SPD
20		RING NUT	
19		WASHER	
18		BRIDGE	
17		SET SCREW	
16		LOWER BODY	
15		LOWER INSERT	
14		UPPER BODY	
13		STUD	
12		CAP SCREW	
11		LIFTING HANDLE	H
10		NIPPLE	Q
09		ADAPTOR 9/16" UNF	A
08		UPPER INSERT	H
07		SET SCREW	
06		SAFETY CAP	H
05		CAP SCREW	
04		SPACER BLOCK ø40mm	H
03		SET SCREW	E
02		BLANKING PLUG	E
01		PULLER BAR	H
ITEM	SUB	DESCRIPTION	P

DRAWN	DATE	LIMITS U.S.D.	MATERIAL	
DM	9/6/98			
SALES ORDER No.	CHECKED	SURFACE FINISH	HEAT TREATMENT	TITLE
S9813759				M75x6 SLIMLINE DOUBLE DECK TENSIONER SHEET 2 OF 2
SALES QUOTE No.	SCALE			
	NTS			

HYDR

DRAWING No.
HTDD1480


ROUGHNESS OF A MACHINED SURFACE
DIMENSIONS IN INS UNLESS OTHERWISE STATED
2 THERMOCOUPLE HOLES
SEE SHT 2 ZONE G5
8 HOLES (4 IN EACH HALF)
DRILL ⅞" DEEP & TAP
½"-13 UNC-2B × ⅝" DEEP
SPACED AS SHOWN HOLES
MUST NOT BREAK THRO
2'-3.375"
2'-3.375"
(ZONE G1)
(ZONE G4)
2'-6.4375"
2'-6.4375"
THERMOCOUPLE HOLE
SEE SHT 2 ZONE G4
PLAN VIEW ASSEMBLED CYLINDER
5'-4.75"
4'-7.50"
2'-2.6875"
15.625"
14.50"
2 HOLES (1 EACH SIDE)
DRILL 1¼" DEEP TAP
½"-13UNC-2B × 1" DEEP
PLAN VIE
BOTT

IP7007268

APPENDIX D - IP STEAM PATH REPAIR & FARO ARM MEASURING

IP7007269

Intermediate Pressure Section - GENERAL

Casing

At disassembly, the HJ was feeler checked with some distortion or larger joint gap being observed. The shell was warped along the middle of the HJ. The maximum feeler of 0.075" was inserted into the gap. The inner lower shell team cuts were observed at the TE stages 10, 12 and 13. Visual inspection of the diaphragm fits and ledge indicated only normal wear. Only a few bolts were broken at disassembly, which occurred in the inlet bowl area. These bolts were drilled out and replaced.

The IP 8th stage snout seal rings were fabricated by Turbocare.

Prior to assembly, all joints and fits were thoroughly cleaned and stoned. Access cover bolt holes and crossover flange bolt holes were tapped and joints stoned. New gaskets were installed the access cover plates. All bolts were torqued from the middle outward. Triple boiled Linseed was applied to the HJ at assembly. A feeler check of the HJ was performed to ensure the joint was closed. Extra efforts were made to close th HJ by heating and cold stretch within the allowable range. At final, most of the HJ was closed except some areas where a 4 mils feeler gage would entered to a 4" depth.

Both of the HP and IP casing bolts disassembly were done by Mannings USA with their "High Pressure Tensil Bolting" tool and method.

Diaphragms & Buckets

The diaphragms were removed for inspection. Blast cleaning and NDE were performed by Reinhart and Associates. No severe erosion and crack indications were found. There were some signs of foreign object damage (FOD) in the IP sections. Solid particle erosion (SPE) and moisture erosion sere observed on the 8th stage bucket. The 8 stages diaphragm partitions were severely damaged by the CVR screens. The 8 stage diaphragm was replaced with the rebuilt. SPE also found on the 9th, 10th, 11th, and 14th diaphragm partitions. The steam path repair was performed by MD&A. Reference the diaphragm repair report and chart included at the end of this section.

At disassembly, it appeared that there may not have been adequate clearance between the upper and lower keys. All keys were checked for the proper clearance and corrected as required. Prior to assembly, the diaphragms were aligned by Laser Measurement Comp. Reference all alignment data included under a separate section of this report. All diaphragms were checked for the proper sideslip and corrected as required by MD&A as directed during the alignment program.

The actual "L" and "H" clearances indicated that the 9, 10 and 11 diaphragms were dishing between 0.035" to 0.055". Monitoring of changes are required on the next outage.

At assembly an anti-seize lubricant was applied to all fits and centering pins. All bolting was tightened to the required values listed in Table 1, which is included at the end of this section.

Packing

All packing was removed and visually inspected. Radial spill strips showed no signs of rubbing and only minor erosion being observed. N3 and N4 packing were found to be in a satisfactory condition and were found to be within 0.010 inch of design. During this outage, a steam path audit was performed by IPSC personnel. A copy of these findings is included under a separate section of this report and indicates which rows of packing were replaced. The cone extensions revealed no signs of steam cutting or unusual wear.

Prior to assembly, all packing, casings and cone extensions were thoroughly cleaned. Tripled boiled linseed oil was applied to the vertical and horizontal joints of the packing casings and all bolting was tightened to the required values.

Rotor

IP7007270

found to be in a rotor short condition as compared to design. Adjustments were made on the thrust bearing and 'B' coupling, which moved all rotors toward the GE to improve the closing clearances as compared to design. See Clearance report for detail.

At disassembly, the IP in-machine-rotor-runout reading was high. TIR was 21 mils. GE was contacted and both GE and MD&A agreed that the maximum allowable rotor runout should be less than 10 mils. The rotor was set on Continental lathe and runout was found to be only 7 mils. Continental machined and polished the A coupling, GE halve to achieve face and rim of zero run out. The rim and face runouts on the "B" coupling, TE halve were high. It is recommended to machine and polish the face and rim of "B" coupling, TE halve next IP/HP outage.

Boresonics of the rotor bore was performed with no indications being reported. After the rotor bore inspection, the rotor was slow speed balanced on site by Prime Machine.

Align boring of the "A" coupling was done by Continental.

Crossover Piping
The crossover pipe was removed, cleaned and inspected with no unusual signs of wear or distress being observed. The bolting was found to be very tight and numerous bolts and sockets were broken during disassembly. No evidence of leakage was observed at the horizontal joint. New gaskets were installed at assembly.

Delta, Utah

March, 2002, Overhaul

IP Section Turbine Repairs

And Future Recommendations

By Ted Archibald
Mechanical Dynamics & Analysis

IP Section Observations and Recommendations - by Ted Archibald

General Comments:
This IP section was found to be in very good condition. The only unusual significant damage was to the 8th stages, which is attributed to valve screens breaking up and getting into the steam path. The 8th stage double flow diaphragm will be replaced with a spare that has been repaired and HVOC coated. The other IP diaphragms only require "minor" repairs, which are described in more detail in following pages.
The 8th stage buckets on the rotor have damage to their leading edges (also from the valve screen failure), but it does not appear to be serious damage (as observed before NDE inspection). However, edge benching, dressing and polishing will be required of all buckets. Due to other observed SPE of these 8th stage bucket tips (outer 1/3 of vane length under the covers), and SPE of the tenons and fox-holed covers (at the OD), along with expected normal continuing SPE wear, it is recommended that these two rows of buckets be replaced at the next outage. Also, it is recommended that these new buckets be HVOC coated, which should greatly extend their life. If ordered before the next outage, so that all parts are in stock, the replacement and necessary machining should only take about (8) days.
Other less significant findings are presented in following pages.

Recommended Repairs For The Next Major Overhaul:
From wear measurements taken on the IP diaphragm partitions, it is expected that at the next turbine overhaul, "major" partition repairs will be required on both 9th and both 10th stages (eight halves). Other "selected" partition weld repairs will likely be required on the 11th and 14th stages. The 8th stage DF diaphragm, with it's HVOC steam path coating, should not require much repair. The above expected diaphragm repairs is estimated to take 1,500 hours, and include (10) technicians for (15) days. Considering labor, travel time, T&L expenses, materials, consumables, and freight charges, an estimate of cost for these repairs is $160,000.
Replacement of the 8th stage buckets should cost about $45,000 (excluding the price of the new parts) for labor, travel time, expenses, freight, and portable lathe rental. Engineering support cost for two weeks is estimated at $28,000.The above costs are based on current prices, so some adjustments will be required.

APPENDIX E - LOW SPEED BALANCE